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1. Your reference

577

2. Patent application number
(The Patent Office will fill in this part)

0314119.9

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

SINCLAIR, PETER
133 FORT ROAD
LONDON
SE1 5PZ
GB

Patents ADP number *(if you know it)*

8266223001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

MOVING APPARATUS

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

COHEN, ALAN NICOL
2 GROVE PLACE
TATSFIELD
Nr. WESTERHAM
KENT
TN16 2BB

Patents ADP number *(if you know it)*

6963557001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
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NO

Patents Form 1/77

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Continuation sheets of this form	0
Description	8
Claim(s)	3
Abstract	1
Drawing(s)	10

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Date

12. Name and daytime telephone number of person to contact in the United Kingdom A. N. Cohen 01959 577172

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Notes

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Moving Apparatus

The present invention relates to a motion assist apparatus for moving or propelling objects e.g. through the air, more particularly it relates to an apparatus for assisting objects to take of vertically and fly.

Fixed wing aircraft are examples of objects which have mechanisms arranged to enable the object to controllably lift-off from the ground by utilising a runway to generate lift through forward momentum and to fly.

Helicopters are examples of mechanisms ranged to enable objects to lift off vertically from the ground and fly by utilising rotating wings.

This invention is an example of a mechanism arranged to enable the object to controllably lift off vertically from the ground and fly utilising one or two pairs of flapping wings for both lift and directional control.

A prime requirement of mechanisms or apparatus for assisting objects to fly is a low weight in relation to its power output. This is to enable there to be sufficient lift to enable the object to take off from the object of the ground.

Apart from increasing the power to weight ratio increased lift can be obtained by increasing the efficiency of the lifting mechanism. In objects with wings which generate lift by forward movement wing design and configuration are clearly important and in helicopters rotor design and size etc. are critical.

Flying insects generate lift by movement of their wings which have evolved into highly efficient and effective systems for flying. In some of such systems a wing comprises a flexible membrane which changes shape and configuration as it is moved by the insect so the insect is very maneuverable and can fly up and down and may

direction. Such systems are difficult to replicate in man made objects and previous attempts have included complex operating systems. The more complex the system the heavier it tends to be thus requiring more power etc.

A system is described in WO 03/004122.

We have now devised an apparatus for assisting in flying which reduces these problems.

According to the invention there is provided an apparatus for assisting in flying which incorporates a rotational drive mechanism, which drive mechanism comprises (i) a support member attached to a flexible wing at a first mounting point on the wing (ii) a drive means able to impart a linear oscillation to the support member (iii) a second mounting point on the wing attached to the drive means spaced apart from the support member whereby, when the drive mechanism operates the support member moves linearly and the wing flexes due to the relative motion of the support and the second mounting point to produce angular wing movement.

Preferably the drive member is an offset cam mounted on a back plate at an angle to the back plate with the support member attached to a cam follower and the second mounting point attached to the back plate.

Preferably the cam is adjustable so that the cam angle can be adjusted during motion.

Preferably there is a drive shaft connected to the axle of the drive member through a universal joint, the drive shaft and the axle of the drive member being at an angle to each other, there being a rotor connecting member mounted on the drive shaft which is connected to the drive member at one location.

The first mounting point is preferably adjacent the leading edge of the wing and the

second mounting is nearer the trailing edge of the wing. In use the drive mechanism is configured so that, as the rotor rotates, the leading edge of the wing stays substantially at the front of the wing.

Preferably the leading edge of the wing articulates separately from the rest of the wing.

The support means preferably is a rod or strut which is pivotally attached along the wing.

The back part of the wing is also pivotally mounted along its length to the wing shaft. and the trailing edge of the back part of the wing pivots e.g. up to 150 degrees (relative to the front part of the wing) around the wing shaft, and back again, while the wing shaft oscillates backwards and forwards on each full wing stroke.

On way of achieving this is to connect an articulating member to the trailing edge of the back part of the wing, parallel to the wing shaft. A second member is pivotally connected to the free end of the first member and then connected to the back plate.
A circular offset cam is mounted to the main drive shaft. A half round (amplifier) cam is mounted to the member connected to the back plate, facing inwards and making edge contact with the offset cam.
As the central cam rotates, it pushes and pulls the half cam thus causing the arm and wing to move backwards and forwards around the wing shaft.

A second way is utilises the differential movement between the cam follower member, and a portion of the back-plate. As the offset cam rotates, it causes the middle part of the cam follower member to rise and fall relative to the back plate.

When the gap is opened to its widest point, the middle has a much larger gap than where the ends meet. The gap closes in a scissor like manner from corner to middle.

This is exploited by utilising the back end of the cam follower member and the edge of the side of the back plate as twin guide rails. (The faces that meet).
A small bus is mounted to a rail via bearings, on the underside of the cam follower arm, and the side of the said portion of the back plate. The rail runs the full length around the cam follower member and the said portion of the side of the back plate. The busses are free to move along the rail from end to end. The busses are then pivotally hinged where one edge of one bus joins the other edge of the opposite bus.

This would mean that when the gap is at its widest, the bus components would be pulled closest to the pivot point. However as the gap closes, the bus component is squeezed by the scissor action of the apposing components and is pushed down and around the guide rails until it reaches its lowest point, before once again the guide rails opening up and pulling the bus component back to the start position.

The trailing edge of the back part of the wing is pivotally and slidably connected to the bus that is connected to the back of the cam follower member.

This configuration allows the wing to attack the air on two planes, on both the up stroke and down stroke respectively

Firstly A linear oscillation along the wing spar, produced by the rise and fall of the offset cam, connected to the cam follower, and an angular motion on the trailing edge of the back part of the wing produced by the incidental scissor type movement exploited by the bus components.

As the wing is flexible this enables the wing to generate lift.

The power source can be any motor which provides a rotary motion to the drive shaft and a flying device will incorporate at least two of the devices of the present

invention mounted opposite each other which can be operated by the same power source.

In an embodiment of the invention the motor, offset cam, and cam follower components are replaced by a linear motor. One end of the linear motor being connected to the back-plate, the other end connected directly to the cam follower member in the same position as the cam follower mount.
The linear motor will oscillate producing a linear oscillation on the wing spar as the offset cam did.

The scissor motion produced by the back plate and the cam follower member, utilised for angular wing movement is unaffected.

The amount of lift generated will depend on the speed of rotation and the area of the wings and will be dependant on the strength of the materials, particularly the wings. A flying device will be able to vertically, fly forwards, backwards, turn in mid air, and land. The mechanism is able to reproduce a defined wing-beat pattern of over twenty beats per second.

The size and shape of wings used with the wing mechanisms has a direct bearing on the wing speed. If sufficient speed is achieved, a pair of wings having an A2 size surface area may be used to lift a man from the ground. The wing membrane can comprise any lightweight flexible material such as polythene, the material simply being glued in place, trimmed, and the ends folded around wing frame portions, e.g. made from carbon fibre rods.

The drive assembly can be made from light and strong materials, such as a composite material. The flying device, including drive assembly, can be made as small as an insect, such as a wasp, or large enough to lift a man from the ground. The drive assembly could be driven by a motor or a glow plug engine with extended drive

shafts acting as wing shafts, and so eliminating the need for a gear assembly.

An adjustable and deflected angle of rotation can be provided by adding a universal joint on each wing shaft, between the motor/engine and the wing mechanism. This would allow the wing mechanism to be fixed in position, and operated above, below, or to the rear of a central point of rotation. The wing mechanism could be arranged to mimic the movement of any flying insect, from a Damselfly to a Goliath Beetle, or a Humming Bird.

It is a feature of the present invention that it can enable a device to take off from a standing start, hover, fly backwards, forwards, and sideways, and turn on a five pence piece.

Any drive mechanism can be used and the apparatus can be driven by any means e.g. motor, engine, linear motor, or possibly even pedal power.

The mechanism of the present invention can be use for propulsion through any fluid e.g. through air as well as water.

The mechanism of the invention can also be adapted for the purpose of manipulating a multi articulating leg mechanism capable of emulating an insect walking gate in which case the support member is attached to a first part of the leg mechanism and the second mounting point attached to a second part of the articulating leg so that a walking motion is imparted to the leg.

The invention is illustrated in the accompanying drawings in which

Figs. 1 to 5 show views of a wing from different angles

Fig. 6 shows a wing with the drive mechanism enclosed in a hub and

Fig. 7 shows a view of the cam arrangement

Fig. 8 shows the mechanism enclosed by a hub

Fig. 9 shows schematically how a drive mechanism can operate and

Fig. 10 shows the use of a linear motor

Referring to figs. 1 to 4 of the drawings, a wing (1) made of a flexible semi rigid material is attached to a support strut (2). The strut (2) is attached to a cam (4) and the wing (1) is also attached to the cam at a second mounting point (3). The cam (4) is mounted on an axle and is attached to a ring (5) which is connected to a frame (7). The ring (5) is connected to the drive shaft (9) by frame (7) and there is a universal joint at (8) connecting (9) and (12).

In use the drive shaft (9) is rotated and the frame (7) rotates the ring (5) which rotates the cam (4). This causes the cam (4) to move relative to drive shaft (9) as shown by the arrows,. As the cam (4) rotates and moves the strut (2) and mounting (3) cause the wing to move and flex with the mounting (3) maintaining the leading edge of the wing (1a) substantially to the front.

Referring to fig. 5 an offset cam (4) rotates, the support member (2) moves from position of fig. 5a to position of fig. 5b, and drive member (25) rotates as shown so that wing mounting (3) is moved through arms (26a) and (26b) to cause wing (1) to flex as the wing mounting moves closer to support (2) by the action of cam (4).

Referring to fig. 6 a small bus or busses (21) is mounted to a rail (12) via bearings, on the underside of the cam follower arm (20) and the side of the said portion of the back plate. The rail runs the full length around the cam follower member (21) and the said portion of the side of the back plate. The busses are free to move along the rail from end to end. The busses are then pivotally hinged where one edge of one bus joins the other edge of the opposite bus.

The trailing edge (22) of the back part of the wing is pivotally and slidably connected to the bus that is connected to the back of the cam follower member.

Referring to fig. 7 the cam ring (4) is attached by telescopic drive plate to race bearing (32). There is an adjustable stabiliser (31) so that the cam angle can be adjusted while in motion.

Referring to fig. 8, the hub (11) encloses the mechanism and which is connected to the wing (1) and front edge (1a) so as to enclose them.

Referring to fig. 7 a drive shaft (11) has a frame (17a, 17b) attached to it so that the frame rotates with the shaft. The frame is attached to a ring (13) so the ring is rotated by the frame. There is an axle (12) attached to shaft (11) at universal joint (16) and the axle (12) has a drive member (14) mounted on it which is attached to ring (13) at point (18). There is a support strut (15) attached to the drive member (14) which is connected to a wing. The wing is attached to the drive member (14) at a second point (not shown).

In use the shaft (11) rotates and the cage (17) rotates ring (13) which causes drive member (12) to rotate and thus move the support member (15) and the wing.

This results in a complex movement of the wing which can cause the wing to generate lift.

Referring to fig. 10 this shows two views of the use of a linear motor as the drive mechanism. In this embodiment, the linear motor (40) drives the front wing axle (41) which moves the wing. The bus (43) moves along bus rail (42) and causes the wing to move to and fro and flex.

Claims

1. An apparatus for assisting in flying which incorporates a rotational drive mechanism, which drive mechanism comprises (i) a support member attached to a flexible wing at a first mounting point on the wing (ii) a drive means able to impart a linear oscillation to the support member (iii) a second mounting point on the wing attached to the drive means spaced apart from the support member whereby when the drive mechanism operates the support member moves linearly and the wing flexes due to the relative motion of the support and the second mounting point to produce angular wing movement.

2. An apparatus as claimed in claim 1 in which the drive member is a rotatable offset cam mounted on a back plate at an angle to the back plate with the support member attached to a cam follower and the second mounting point attached to the back plate.

3. An apparatus as claimed in claim 2 in which the cam angle is adjustable.

4. An apparatus as claimed in any one of the preceding in which is a drive shaft connected to the axle of the drive member through a universal joint, the drive shaft and the axle of the drive member being at an angle to each other, there being a rotor connecting member mounted on the drive shaft which is connected to the drive member at one location.

5. An apparatus as claimed in any one of the preceding claims in which the first mounting point is adjacent the leading edge of the wing and the second mounting is nearer the trailing edge of the wing and in use the drive mechanism is configured so that, as the rotor rotates, the leading edge of the wing stays substantially at the front of the wing.

6. An apparatus as claimed in any one of the preceding claims in which the leading

edge of the wing articulates separately from the rest of the wing.

7. An apparatus as claimed in any one of the preceding claims in which the support means is a rod or strut which is pivotally attached along the wing.

8. An apparatus as claimed in any one of the preceding claims in which the back part of the wing is also pivotally mounted along its length to the wing shaft and the trailing edge of the back part of the wing pivots up to 150 degrees (relative to the front part of the wing) around the wing shaft, and back again, while the wing shaft oscillates backwards and forwards on each full wing stroke.

9. An apparatus as claimed in claim 8 in which an articulating member is connected to the trailing edge of the back part of the wing, parallel to the wing shaft and a second member is pivotally connected to the free end of the first member and then connected to the back plate there being a circular offset cam mounted to the main drive shaft and a half round (amplifier) cam mounted to the member connected to the back plate, facing inwards and making edge contact with the offset cam.

10. An apparatus as claimed in claim 8 in which as the offset cam rotates, it causes the middle part of the cam follower member to rise and fall relative to the back plate and when the gap is opened to its widest point, the middle has a much larger gap than where the ends meet, the gap closing in a scissor like manner from corner to middle with the back end of the cam follower member and the edge of the side of the back plate as twin guide rails there being a small bus mounted to a rail via bearings, on the underside of the cam follower arm, and the side of the said portion of the back plate, the rail running the full length around the cam follower member and the said portion of the side of the back plate with the busses being free to move along the rail from end to end and are then pivotally hinged where one edge of one bus joins the other edge of the opposite bus.

11. An apparatus as claimed in any one of the preceding claims in which the support means is a rod or strut which is pivotally attached along the wing.

12. An apparatus as claimed in any one of the preceding claims in which the drive mechanism is arranged such that the drive member follows a generally rotary, preferably circular cyclic motion.

13. An apparatus as claimed in any one of the preceding claims in which each web comprises a lightweight plastics material which is secured to a frame

14. A flying device which incorporates at least two of the apparatus as claimed in any one of the preceding claims together with a motor to rotate the rotor.

15. An apparatus as claimed in any one of the preceding claims in which the drive member is a linear motor with one end of the linear motor being connected to the back-plate, the other end connected directly to the cam follower member in the same position as the cam follower mount.

16. An apparatus as claimed in any one of the preceding claims adapted for manipulating a multi articulating leg mechanism capable of emulating an insect walking gate in which the support member is attached to a first part of the leg mechanism and the second mounting point attached to a second part of the articulating leg so that a walking motion is imparted to the leg.

Abstract

An apparatus for assisting inn flying has a wing attached to a drive mechanism in which the end of wing flexes and moves in a figure of eight path and generates lift.

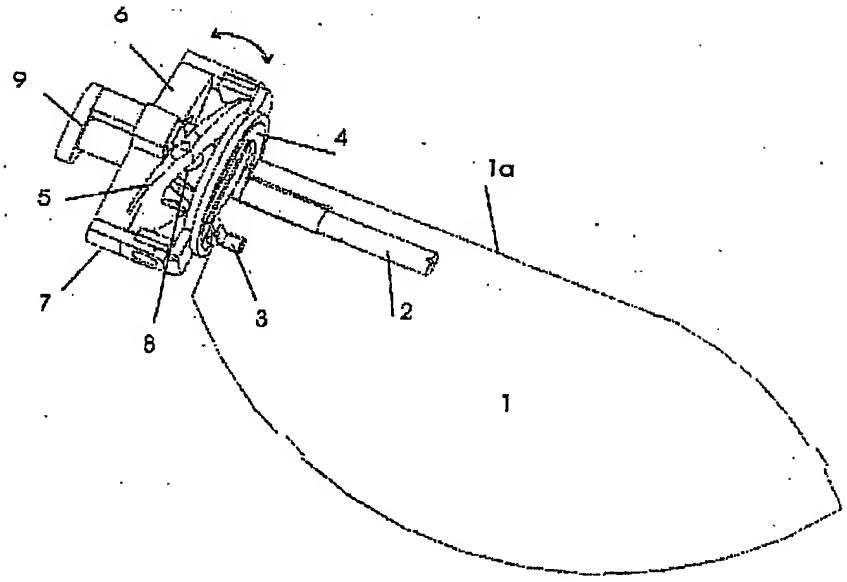

Fig. 1

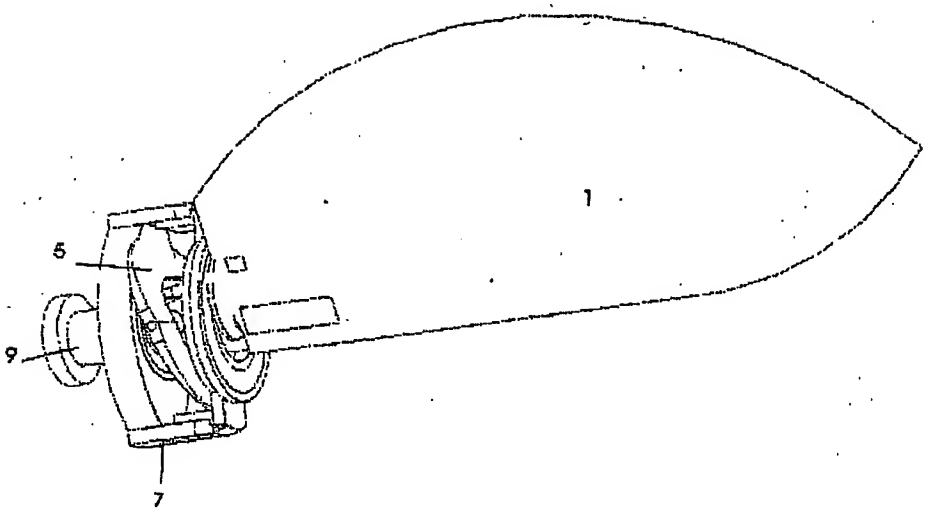

Fig. 2

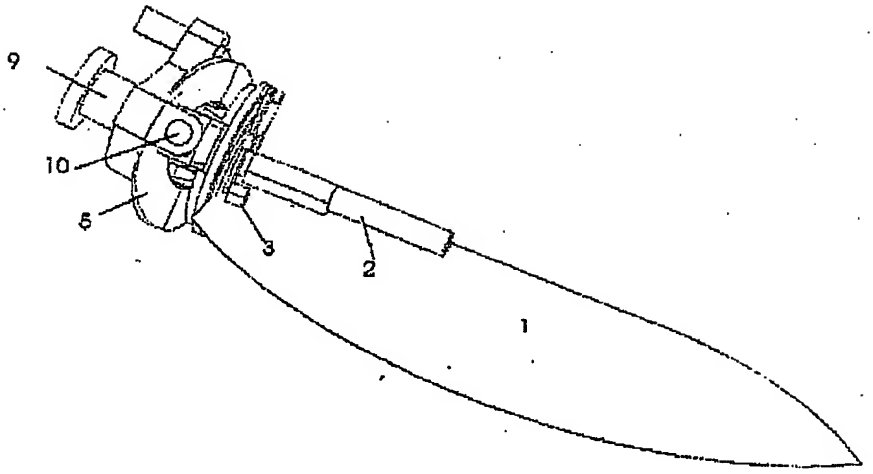

Fig. 3

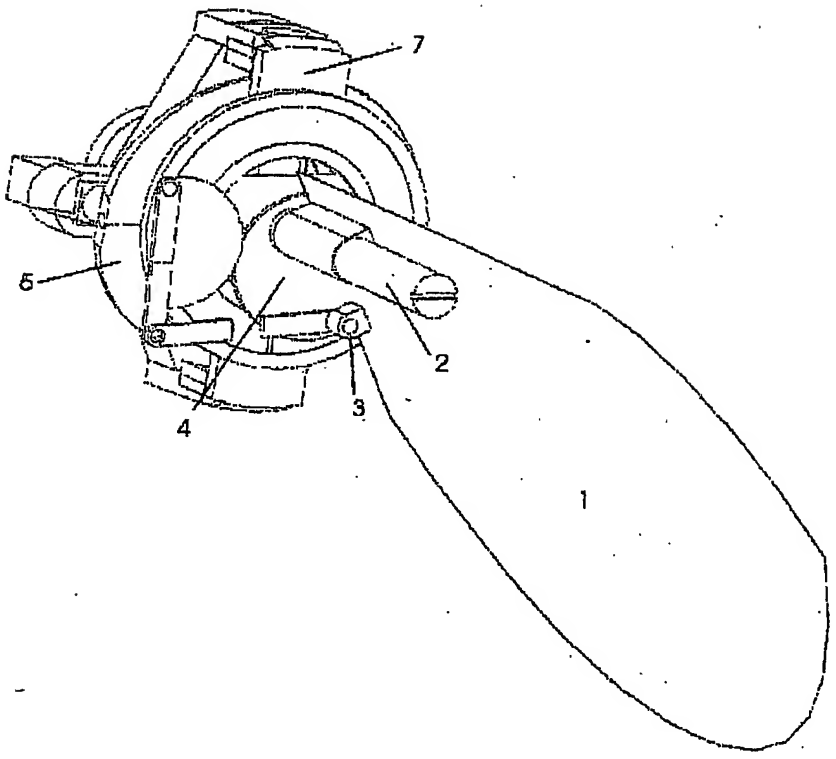

Fig. 4

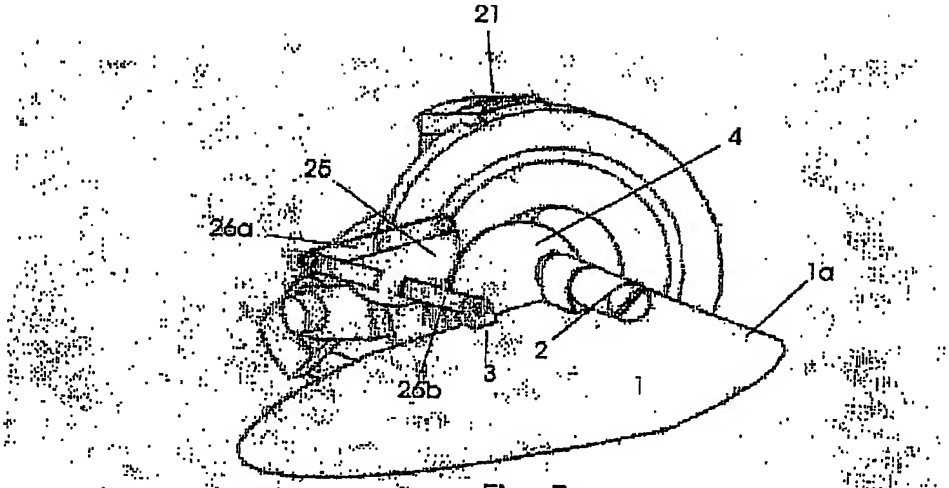

Fig. 5a

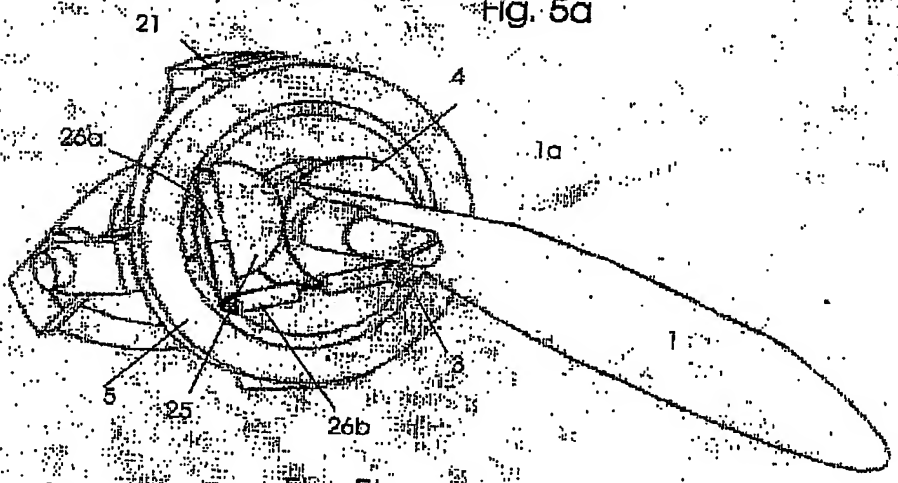

Fig. 5b

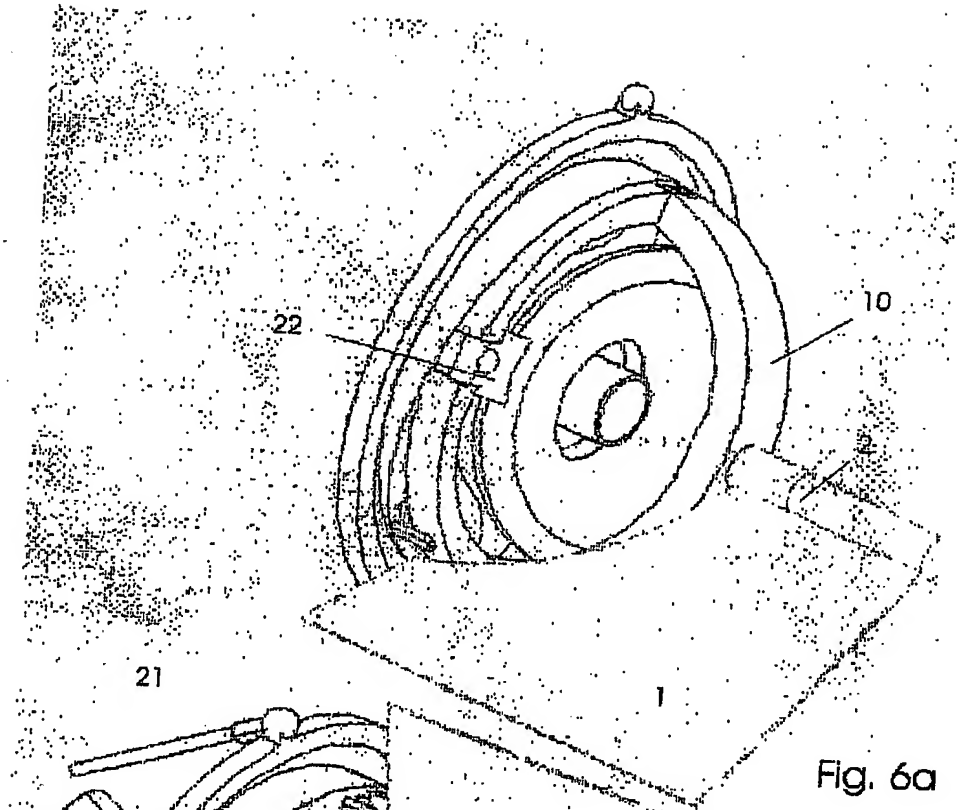

Fig. 6a

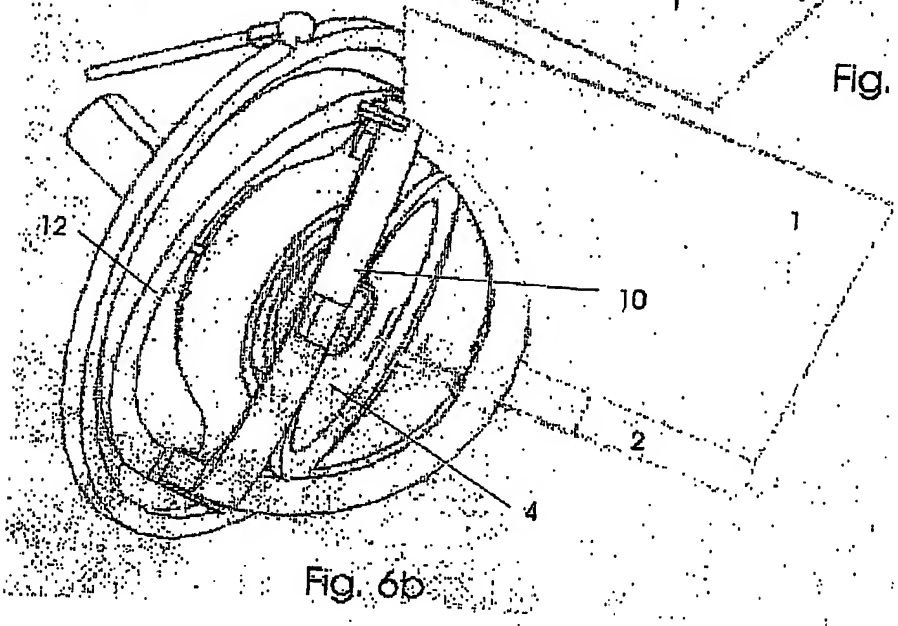

Fig. 6b

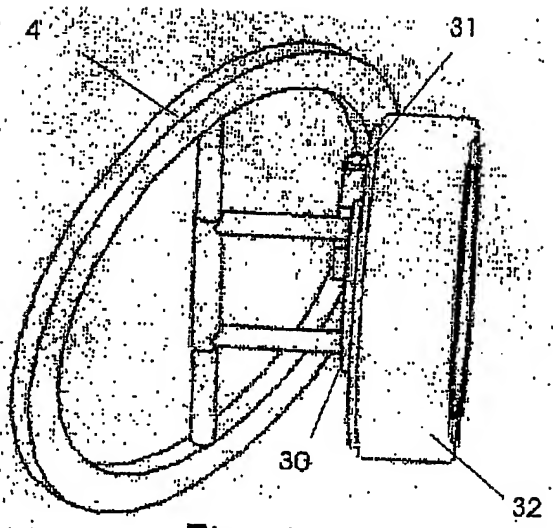

Fig. 7a

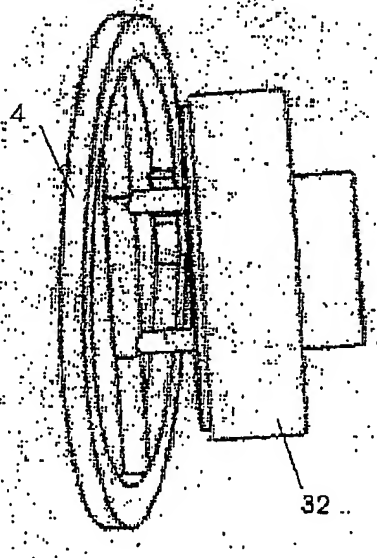

Fig. 7b

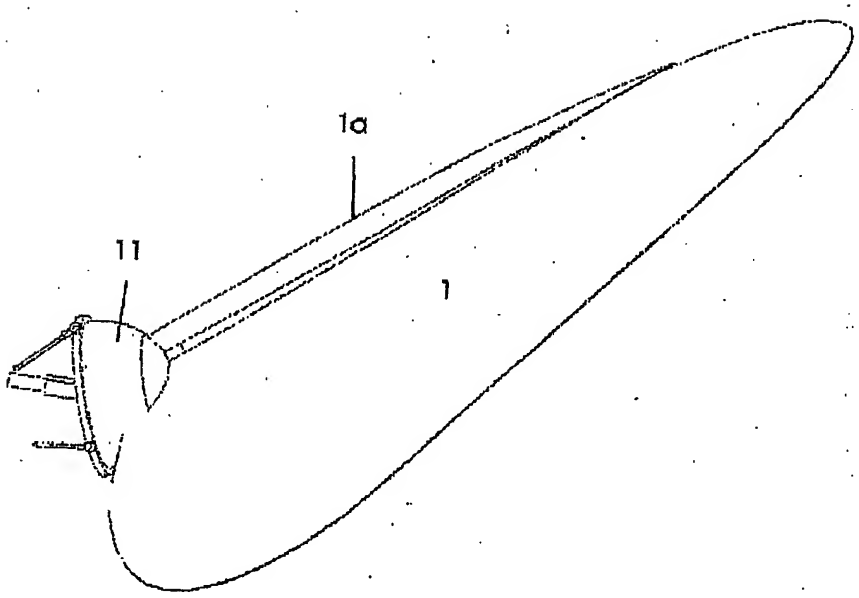

Fig. 8

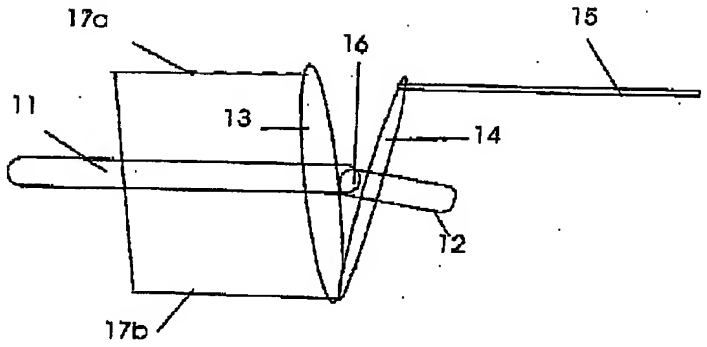

Fig. 9a

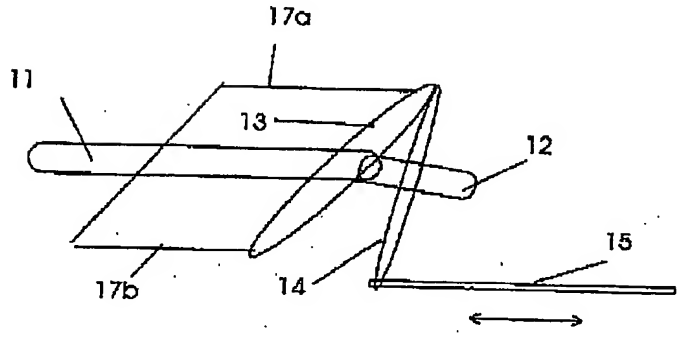

Fig. 9b

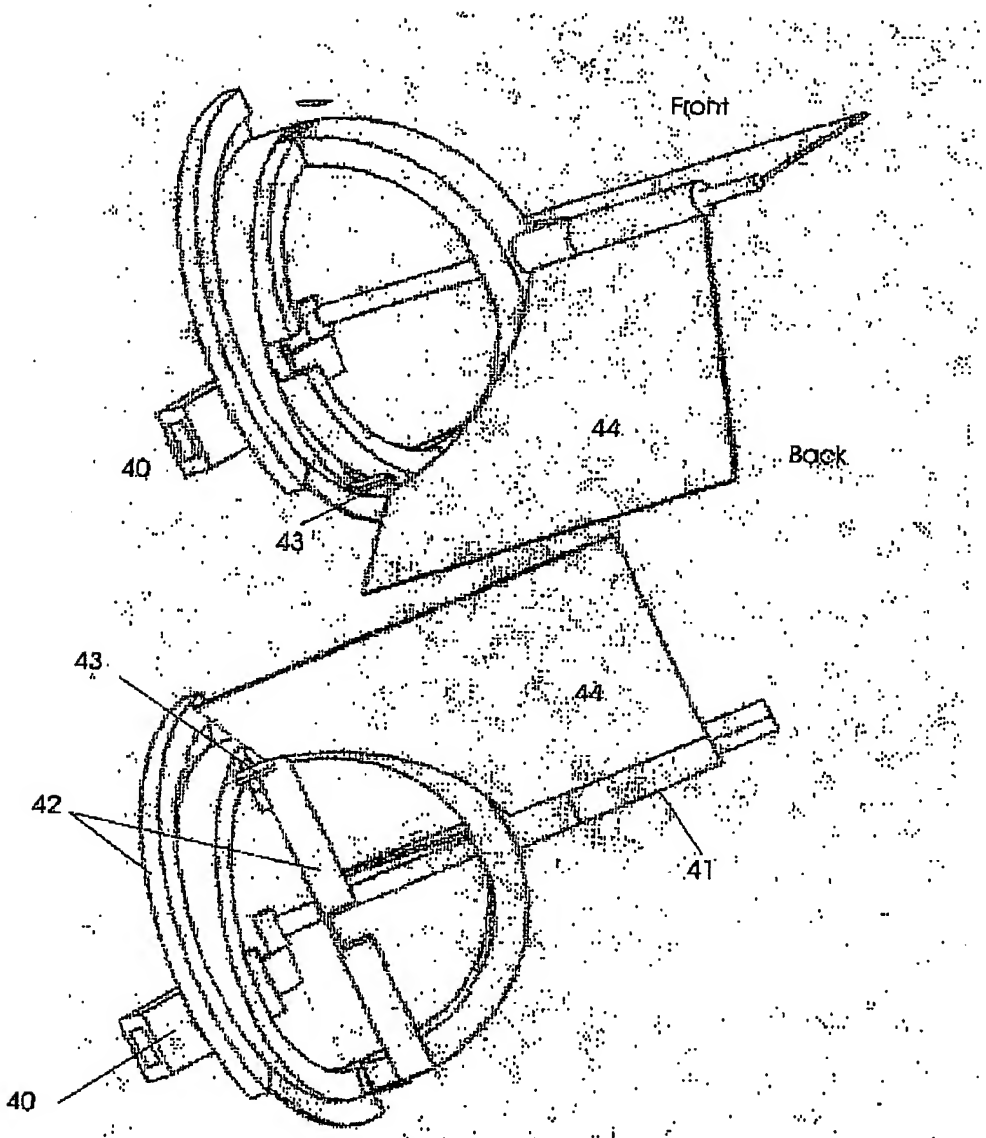

Fig. 10